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REPORT OF INVESTIGATIONS—NO. 122

UPPER KINKAID (MISSISSIPPIAN) MICROFAUNA FROM JOHNSON COUNTY, ILLINOIS

BY

CHALMER L. COOPER

REPRINTED FROM THE JOURNAL OF PALEONTOLOGY,
VOL. 21, NO. 2, MARCH, 1947

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

URBANA, ILLINOIS

1947

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Topographic Mapping in Cooperation with the United States Geological Survey.
This report is a contribution of the Division of Areal Geology and Paleontology.

March 15, 1947

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UPPER KINKAID (MISSISSIPPIAN) MICROFAUNA FROM JOHNSON COUNTY, ILLINOIS

CHALMER L. COOPER
U. S. Geological Survey

ABSTRACT—In northwestern Johnson County, Illinois, the Wayside formation (Lower Pennsylvanian) rests with apparently slight disconformity upon the Kinkaid formation (upper Chester). An important and varied microfauna, consisting of Foraminifera, ostracodes, and conodonts is described and compared with Morrow microfaunas from the Midcontinent and other areas. The Foraminifera include the genera *Endothyra*, *Glomospira*, *Hyperammina*, *Palaeotextularia*, *Trepeilopsis*, and *Millerella*. The last is specifically described from the Mississippian for the first time. Five genera of conodonts and 20 genera (35 species) of ostracodes are included in the fauna.

THIS paper presents the microfauna from beds that are thought to be the youngest Chester in the area regarded as the type for the Mississippian system, where these beds could be examined and studied in relation to the superjacent Pennsylvanian. The type area for the Kinkaid formation is located along Kinkaid Creek, which cuts through the formation in NW. ¼ sec. 6, T. 8 S., R. 4 W., Jackson County, Illinois. This is less than 15 miles southeast of the town of Chester and the locality from which the fauna in question was collected is about 40 miles southeast of Chester. All known outcrops of the Kinkaid in southern Illinois that might show the contact with the overlying Pennsylvanian were visited in order to obtain as much data as possible on the contact relations of the Pennsylvanian-Mississippian boundary. The best section observed is that exposed on a north tributary of Lick Creek, which flows southeast across sec. 31, T. 11 S., R. 2 E., crossing the upper Kinkaid boundary in the northwest quarter of the section. This outcrop was described in detail by Lamar (1925, p. 80) who measured about 30 feet of Pottsville (Wayside) overlying 91 feet of the Kinkaid formation, the latter containing about one-third shale and two-thirds limestone. The details of the contact relations, modified somewhat from Lamar's subdivisions, are shown in figure 1.

A coral fauna from these beds was described by Easton (1945) who correlates the Kinkaid beds containing *Kinkadia trigonalis*, *Triplophyllites palmatus*, and *Caninostrotion variabilis* with the upper part of the Pitkin formation of western Arkansas. These corals were obtained from the massive limestone at the base of the section (fig. 1) and the thin limestones a short distance above it (between samples 2 and 5). Concerning the coral fauna he concluded (p. 384):

. . . the geographic distribution of the corals

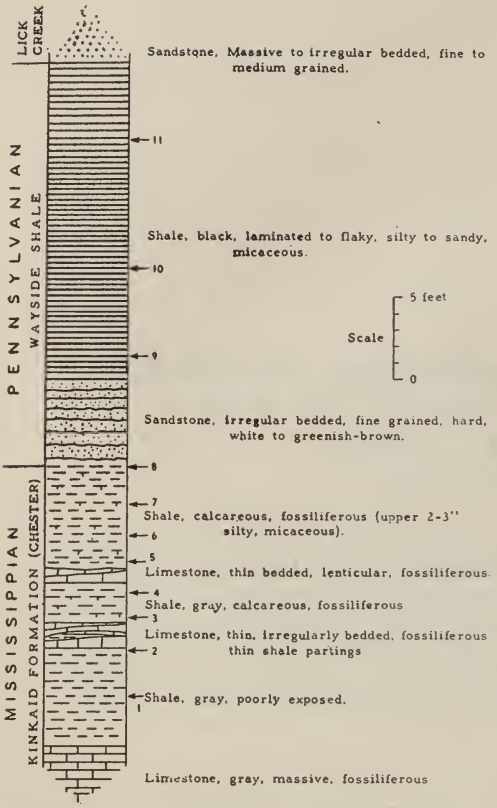


FIG. 1—Mississippian-Pennsylvanian contact in Johnson County, Illinois. The arrows to the right of the column show the approximate position of samples collected for study. The beds were sampled so that all zones from the top of the massive limestone at the bottom of the column to the base of the Lick Creek sandstone were collected.

shows that the two basins (Arkansas and Illinois) were connected and that favorable ecologic conditions of unknown duration enabled faunal migration of some distinctive organisms.

All zones in the Kinkaid shales above the massive limestone shown at the base of the column in figure 1 contain a microfauna in varying amounts, principally ostracodes. However, the samples above and below the upper thin irregularly bedded limestone proved to be the most fruitful, zone 5 furnishing the fusulines which are described later. The Wayside shales above the Kinkaid are barren of fossils.

A short time ago the very primitive, short axis fusuline, *Millerella*, was described by Thompson (1942, p. 404). The holotype came from the type locality of the Marble Falls formation in Burnet County, Texas, and the paratypes were collected from the "Bend" series in the Hueco Mountains of

EXPLANATION OF PLATE 19

FIGS. *1–5*—*Millerella chesterensis* Cooper, n. sp. *1*, *4*, Saggital sections with endothyroid juvenaria, and irregular coiling as shown by the elongate volution and lack of continuity of the tunnel in the plane of the section, ×100. *2*, *3*, Axial sections, showing modified hour-glass outline, ×100. *5*, Enlargement of *1* to show details of coiling of first volution in a plane at right angles to the plane of the section, ×200. Kinkaid formation, bed 5, Johnson County, Illinois. (p. 85)

6–8—*Millerella zelleri* Cooper, n. sp. *6*, *8*, Sagittal sections showing uniformity of coiling and tunnel, the latter lying almost wholly in the plane of the section, ×100. *7*, Axial section, ×100. Kinkaid formation, bed 5, Johnson County, Illinois. (p. 86)

9, *11*—*Millerella kinkaidensis* Cooper, n. sp. Sagittal and axial sections, the latter showing the relatively long axis and modified keel-like margin, ×100. Kinkaid formation, bed 5, Johnson County, Illinois. (p. 86)

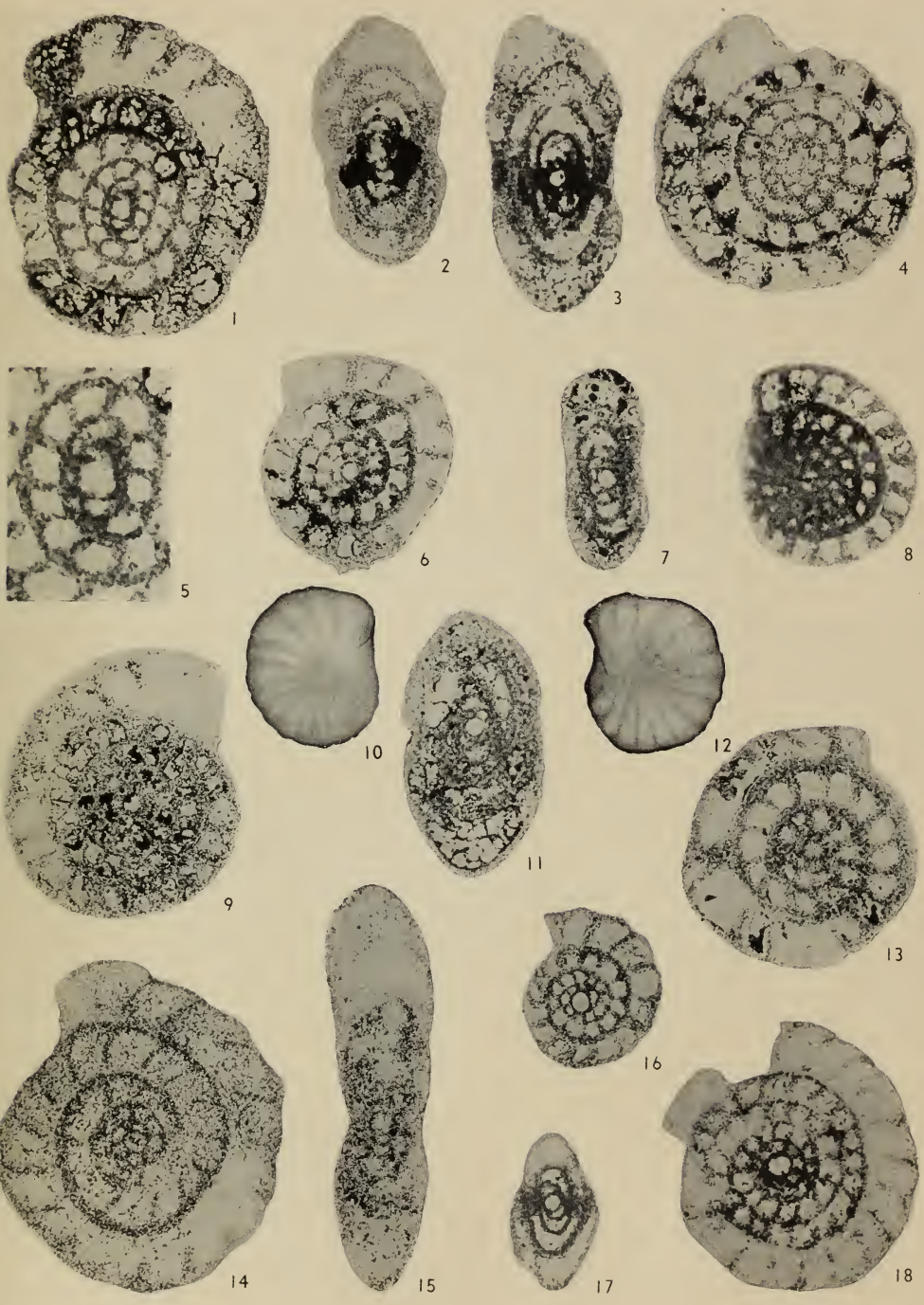
10, *12*—*Millerella* sp. External views of two specimens, ×60. (p. 83)

13—*Millerella* cf. *M. pinguis* Thompson. Sagittal section, ×100. Dornick Hills group, sec. 12, T. 3 S., R. 2 E., Carter County, Oklahoma. (p. 83)

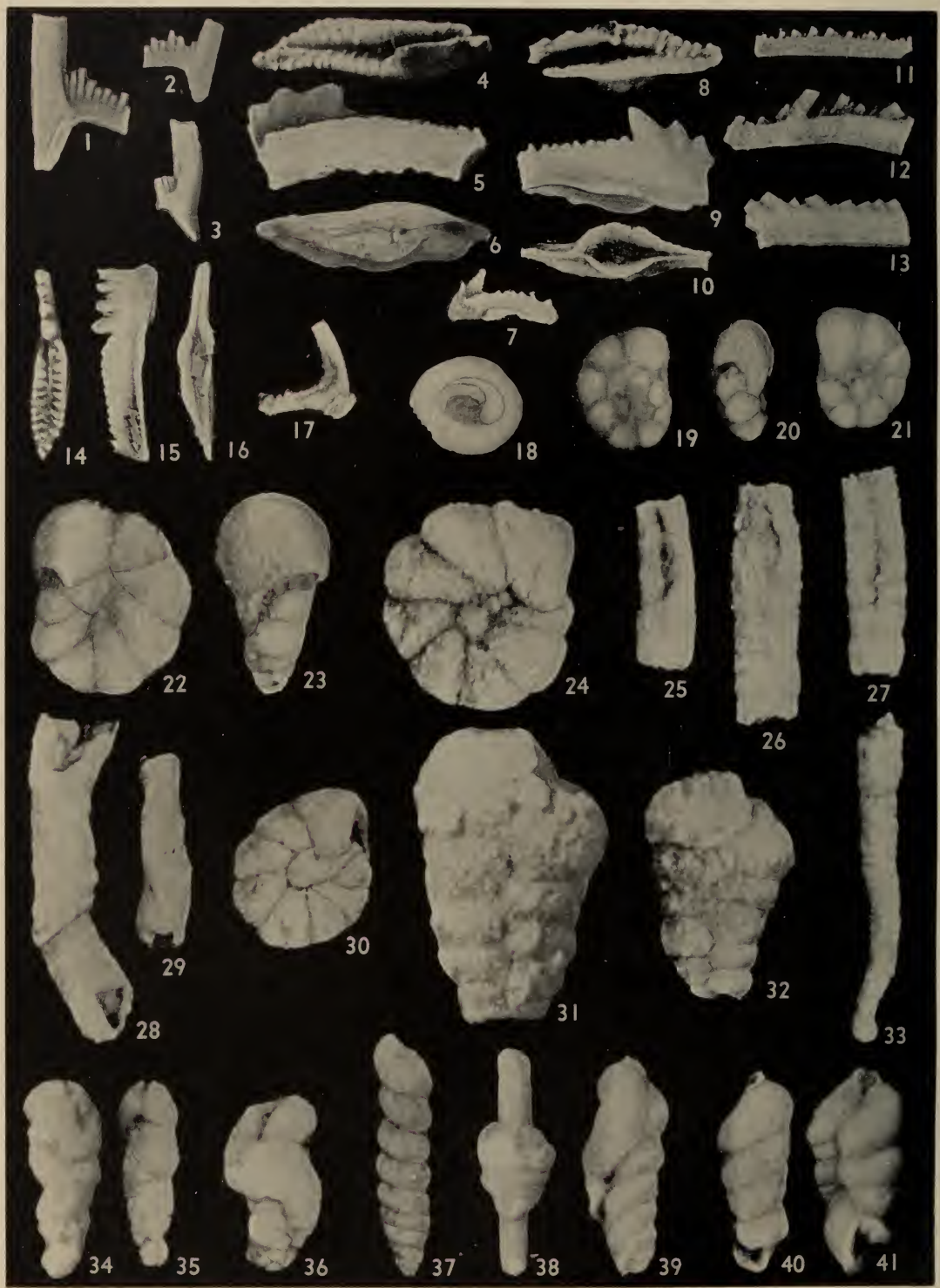
14–15—*Millerella marblensis* Thompson. Sagittal and axial sections, ×100. Same horizon and locality as fig. 13. (p. 83)

16–17—*Millerella advena* Thompson. Sagittal and axial sections, the latter showing inflated character and eccentric coiling of early volution, ×100. Lower Dornick Hills group, NW. ¼, NW. ¼, NE. ¼, sec. 16, T. 6 S., R. 2 E., Carter County, Oklahoma. (p. 83)

18—*Millerella inflecta* Thompson. Sagittal section from the Belden formation, bed 15, section P-15, Sweetwater Creek. Near Glenwood Springs, Colorado, ×100. (Thompson, 1945, p. 44, pl. 1, fig. 5.) (p. 83)



Cooper, Carboniferous *Millerella*



Cooper, Chester Conodonts and Foraminifera

Texas and the Mud Springs Mountains in central New Mexico. Later, Thompson (1944, p. 420) discovered the genotype species, *M. marblensis*, in the Brentwood limestone at the well-known type section of the Morrow group in northwestern Arkansas, and defined the zone of *Millerella* as that part of the stratigraphic section containing this fusuline to the exclusion of the normal long-axis forms. He also stated that

> It is entirely possible, if not probable, that species of *Millerella* or of a closely allied ancestral genus of fusulinids will be found in rocks of Mississippian age.

Later (1945, p. 42) he stated that

> All fusulinids so far discovered in the Belden formation (Idaho) are referable to the genus *Millerella*, which was originally described from the upper part of the Marble Falls limestone of Texas. Congeneric species are known to occur stratigraphically from near the base of the Morrowan series to near the top of the Pennsylvanian system. It is probable that further study will demonstrate the occurrence of *Millerella* in rocks older than Morrowan.

Endothyra has long been considered by some as the progenitor of the fusulinids (Galloway, 1933, pp. 388, 393; Dunbar and Henbest, 1942, p. 52) but most fusuline students have considered that the true Fusulinidae were confined to the Pennsylvanian and Permian. However, the recognition of *Millerella* in zones of the upper Chester in the type area demonstrates conclusively the occurrence of true fusulines in Mississippian rocks as Thompson predicted.

The thin sections of Chester *Millerella* were shown to Dr. Thompson at the Pittsburgh meeting of the Geological Society of America, and they were later sent to him for direct comparison with his described material. He states that "I have compared the specimens you sent me with all other similar forms I have in the laboratory. So far as I can tell they are more closely similar to the types of *Millerella inflecta* from the Belden formation of northwest Colorado."[1]

There are, however, some important and easily recognized differences between the Chester forms (pl. 19, figs. 1–12) and those previously described (pl. 19, figs. 13–18), consequently the older forms are described as new species. These distinguishing features are as follows:

1. The very strongly rounded periphery.
2. The relatively short, straight septa rapidly widening near the outer wall and producing a structure which is Δ-shaped in cross section (see sagittal sections), in contrast to the thin,

[1] Personal communication, January 27, 1946

EXPLANATION OF PLATE 20

FIGS. *1–3—Prioniodus scitulus* Branson and Mehl. Lateral views, ×20. (p. 92)
4–10—Cavusgnathus cristata Branson and Mehl. Oral, aboral, and lateral views; *4–6*, *8–10*, ×20; *7*, ×30. (p. 91)
11–13—Hindeodella sp. Lateral views; *11*, ×20; *12*, *13*, ×30. (p. 91)
14–16—Taphrognathus varians Branson and Mehl. Oral, lateral and aboral views, ×30. (p. 92)
17—Ligonodina cf. *L. levis* Branson and Mehl. Lateral view, ×30. (p. 91)
18—Glomospira disca Cooper, n. sp. Lateral view of holotype, ×60. (p. 87)
19–23—Endothyra excentralis Cooper, n. sp. *19*, *21*, Lateral views and *20*, aperatural view of a young specimen; *22*, lateral view of holotype showing involute right side and greatly enlarged final chamber; *23*, apertural view of holotype. ×60. (p. 88)
24, *30—Endothyra acuta* Cooper, n. sp. Lateral views, ×60. *24*, Holotype, showing umbilicus, depressed sutures, and sharply curved outer margin of chambers, bed 5. *30*, Smaller specimen showing highly arched aperture, bed 4. (p. 88)
25–27—Hyperammina cf. elongata clavulata Howchin. Lateral views of three fragmentary specimens, ×60. (p. 88)
28, *29—Hyperammina* sp. Lateral views, ×60. (p. 89)
31, *32—Palaeotextularia asper* Cooper, n. sp. Lateral views, ×60. *31*, Holotype. (p. 89)
33—Hyperammina cf. *H. glabra* Cushman and Waters. Lateral view of a nearly complete specimen, with initial chamber, ×50. (p. 89)
34–41—Trepeilopsis mississippiana Cooper, n. sp., Lateral views, ×60. *36*, *39*, *41*, Specimens showing tube bent back over earlier whorls; *38*, specimen coiled about a *Productus* spine; *37*, regular coils without development of straight portion. *34*, *35*, from bed 1; *36*, *38*, *40*, *41*, beds 5, 6; *37*, bed 7; and *39*, bed 4. *40*, *41*, Two views of the holotype, showing wide, flaring aperture. *34*, *35*, Two views of a single specimen. (p. 87)

more strongly curved septa of Pennsylvanian species.
3. The eccentricity of coiling, particularly in earlier volutions.
4. The modified hour-glass shape as visible in axial sections and the variation in degree of concavity of the two sides.
5. The endothyroid juvenarium of some species.

Based upon differences of size of proloculum, height of volutions, form ratio, and septal count, three new species are recognized in the Kinkaid fauna, namely *M. chesterensis* (pl. 19, figs. 1–5), *M. zelleri* (pl. 19, figs. 6–8) and *M. kinkaidensis* (pl. 19, figs. 9, 11). In general the Chester species are intermediate in form between the two extremes from the Pennsylvanian, namely, *M. marblensis* and *M. adrena* (see sagittal sections), having thicker shells than the former and lacking the inflated umbilical area of the latter. While the number of chambers per volution are about the same, the shorter, thicker septa of the Mississippian forms result in proportionally smaller chambers.

Millerella (species undescribed) from the Pitkin (upper Chester) of Arkansas has been reported by Henbest (1946). Representatives of the genus are also known to occur with Chester species of *Archimedes* and trilobites in beds of the Amsden formation in Wyoming (Zeller, 1946, personal communication).

In addition to the fusulines several genera of smaller Foraminifera are present in the Kinkaid microfauna (pl. 20, figs. 23–26). There are two new species of *Endothyra*, one of which, *E. acuta*, is suggestive of *E. whitesidei* Galloway and Ryniker, known heretofore from the Atoka of Oklahoma and the Marble Falls of Texas. The other is similar to *E. media* Waters, *E. rothrocki* Harlton and *E. distenta* H. J. Plummer, from horizons in Oklahoma and Texas well above the Morrow zone and considerably younger than the Kinkaid. The flattened cylindrical forms with the irregularly spaced constrictions marking successive chambers closely resemble those from the Johns Valley shale of Oklahoma described as *Hyperammina elongata clavatula* Howchin by Harlton (1933, p. 8). A species of *Palaeotextularia* is not like the Johns Valley species. The extremely irregularly coiled *Trepeilopsis* is abundant and shows the variable nature of these forms. This genus is known to occur as low as the Chouteau (or Rockford), although described species are restricted to the Pennsylvanian. Significant is the absence of such characteristically Pennsylvanian genera as *Polytaxis*, *Tetrataxis*, *Endothyranella*, and *Reophax*.

Chester and Morrow conodont literature consists of only one paper for each of these subdivisions (Branson and Mehl, 1940 and Harlton, 1933). The conodonts in the Kinkaid are strongly Mississippian in character containing none of the typically Pennsylvanian forms described by Harlton from the Johns Valley. The two species of *Prioniodus*, *P. scitulus* and *P. varians*, are not known from beds younger than Chester. A common Pennsylvanian genus, *Cavusgnathus*, is represented by *C. cristata* which is easily distinguished from younger species. The specimens of *Hindeodella*, while not identifiable specifically, possess denticulated bars similar to those described from the Caney shale. A species of *Taphrognathus*, not known heretofore above the Keokuk, gives a distinct Mississippian aspect to the Kinkaid fauna.

The ostracodes are of the greatest value for determining the age of this fauna. The literature contains two fairly complete papers describing Kinkaid ostracodes (Croneis and Thurman, 1938 and Cooper, 1942) and several additional papers describe other Chester faunas. Information on Lower Pennsylvanian ostracodes is contained largely in papers by Roth (1929) and Harlton (1929, 1933).

Plate 21 shows such typical upper Chester species as *Balantoides reticulatus* Croneis and Thurman (figs. 1–3), the three species of *Bairdia*, *B. golcondensis* Croneis and Gale (figs. 25, 26), *B. attenuata* (figs. 27, 28), and *B. impendere* Cooper (figs. 29, 30), *Beyrichiopsis thori* Coryell and Johnson (fig. 13), and the two species of *Ectodemites*, *E. planus* Cooper (figs. 9–12) and *E. tumida* Cooper (figs. 14–16). However, the *Cornigella* (figs. 4–6) is indistinguishable from *C. tuberculospinosa* (Jones and Kirkby) listed by Harlton as *C. pushmatahensis* in his Johns Valley fauna which has a long range in the Pennsylvanian. Also *Amphissites insignis* Corneis and Thurman (figs. 19–22), differs

little from *A. marginiferus* Roth from the Union Valley and Wapanucka formations of Oklahoma.

Glyptopleurina iniqua (pl. 22, fig. 35) and *Hollinella radiata* (Jones and Kirkby) (figs. 20–23) are typical, easily recognized, and range no higher than the Chester. However, without close examination *Glyptopleura similis* Croneis and Funkhouser (figs. 32–34) might be confused quite easily with *G. coryelli* Harlton which has a long range in the Pennsylvanian. The species of *Healdia* are characteristically Chester.

Other good Chester markers, are *Glyptopleura tyri* Coryell and Johnson (pl. 23, figs. 9–11), *Perprimitia funkhouseri* Croneis and Thurman, (figs. 15–17), *Polytylites quincollinus* Harlton (fig. 25), and *Sargentina crassimarginata* Cooper (figs. 30–34). However, the reversed forms of *Sansabella harrisi* Croneis and Funkhouser (figs. 26–29) might easily be mistaken for *S. carbonaria* Cooper from the Pennsylvanian.

In summary, the fauna described is from the youngest Mississippian beds in the type area, which can be studied in connection with the Mississippian-Pennsylvanian contact. While predominantly Chester, the microfauna reflects other Chester faunal and sedimentological characteristics in that it heralds the approaching Pennsylvanian by showing a distinct break from the Middle Mississippian, while at the same time containing some early Pennsylvanian elements. All of the fauna, with the exception of the foraminifer *Trepeilopsis* and the ostracode *Hollinella radiata* show a complete lack of Middle or Lower Mississippian affinity, while most of the Foraminifera, including the fusuline *Millerella*, and some ostracodes and conodonts have a distinctly Pennsylvanian character.

SYSTEMATIC DESCRIPTIONS

Order Foraminifera d'Orbigny, 1826
Family Fusulinidae Möller, 1878
Genus Millerella Thompson, 1942

Millerella Thompson, 1942, Am. Jour. Sci., vol. 240, no. 6, p. 404.—Thompson, 1944, Kansas Geol. Survey, Bull. 52, p. 419.—Thompson, 1945, idem., Bull. 60, p. 40.

Shell disc-shaped, periphery angular to rounded, usually completely planispiral, but some species may have an endothyroid juvenarium while others have only slight irregularities in coiling; volutions 4 to 7, completely involute to slightly evolute; evolute species depressed or concave in polar area (umbilicate) and convex in involute forms; diameter one-fourth to one-half millimeter, axis usually one-fourth to one-third the diameter; spirotheca thin and believed to possess three walls, septa thin and long to short and thick (Δ-shaped); proloculum very minute; tunnel and chomata usually well developed.

The above generic description is essentially that of Thompson (1942, p. 404) but modified to include many subsequently described species, including those from the Kinkaid. The latter are entirely consistent generically with the Pennsylvanian forms and differ only in those minor structural features which are usually considered specific.

Millerella chesterensis Cooper, n. sp.
Plate 19, figures 1–5

Shell very small, discoidal, periphery rounded; juvenarium endothyroid, essentially planispiral; spirotheca and septa thick, the latter almost Δ-shaped in section, essentially straight, but directed forward making an angle of about 65°, on the average, with spirotheca; coiling elongate about juvenarium, resulting in an elongate peripheral outline in sagittal section; last volution partially evolute, forming a slightly umbilicate shell, the degree of concavity being unequal on opposite sides.

Data on shell measurements and septal counts is shown in table 1.

M. chesterensis differs from *M. marblensis* Thompson in its smaller size, shorter, thicker septa, larger tunnel angle, rounded periphery (see axial sections) and is almost completely involute. *M. inflecta* Thompson, although quite similar in axial section has thinner spirotheca and septa, greater regularity of coiling, a nonendothyroid juvenarium, and larger proloculum, diameter and form ratio.

Kinkaid formation, bed 5, Johnson County, Illinois.

TABLE 1.—STATISTICAL DATA FOR *M. chesterensis*, MEASUREMENTS IN MICRONS

Spec.[1]	Septal Count					Prol. Diam.	L.	W.	Ratio	Ht. Volutions					Tunnel Angle
	1	2	3	4	5					1	2	3	4	5	
1	—	11	14	18	114	20	—	—	—	13	20	27	40	—	
2	—	9	13	15	17	20	—	—	—	—	20	27	40	53	
3	—	—	—	—	—	20	160	430	1:0.37	13	40	53	60	61	21°
4	—	—	—	—	—	20	140	350	1:0.40	13	20	27	40	60	21°

[1] Specimens 1 and 2 are sagittal sections, 3 and 4 are axial sections. Specimen 1 is illustrated in pl. 19, figs. 1, 5; 2, fig. 4; 3, fig. 4; and 4, fig. 2.

MILLERELLA KINKAIDENSIS Cooper, n. sp.
Plate 19, figures 9, 11

Shell small, discoidal; periphery subrounded, involute, and only slightly umbilicate; walls thick, septa short, thick and slightly curved; chambers small and about as wide as high (see sagittal section); proloculum relatively large; juvenarium endothyroid. Data on shell measurements and septal counts is shown in table 2.

M. kinkaidensis has a longer axis and larger proloculum than the other two Kinkaid species of *Millerella*. It differs from Pennsylvanian species much as the other Kinkaid species do.

Kinkaid formation, bed 5, Johnson County, Illinois.

MILLERELLA ZELLERI Cooper, n. sp.
Plate 19, figures 6–8

Shell very minute, regularly coiled, septa very short, thick, tapered, closely spaced, forming rather small chambers; periphery rounded; axial regions slightly and nearly equally umbilicate, completely involute; juvenarium endothyroid, but nevertheless the coiling is regular.

Data on shell measurements and septal counts is shown in table 3.

M. zelleri is distinguished from *M.*

TABLE 2.—STATISTICAL DATA FOR *M. kinkaidensis*, MEASUREMENTS IN MICRONS

Spec.[2]	Septal count				Diam. Proloc.	L.	W.	Ratio	Ht. volutions					Tunnel angle
	1	2	3	4					1	2	3	4	5	
1	8	13	16	20	26	—	—	—	13	20	27	46	46	—
2	—	—	—	—	23	18	36	1:0.50	—	20	33	46	74	±30°

[2] Specimen 1 is a sagittal section, 2 an axial section. Specimen 1 is shown on pl. 19, fig. 9; 2, fig. 11

EXPLANATION OF PLATE 21

FIGS. *1–3—Balantoides reticulatus* Croneis and Thurman. Dorsal, lateral and end views, ×50. (p. 84)

4–6—Cornigella tuberculospinosa (Jones and Kirkby). Dorsal, lateral and end views, ×50. (p. 89)

7–8—Cornigella golcondensis (Croneis and Gale). Dorsal and lateral views, ×50. (p. 90)

9–12—Ectodemites planus Cooper. Dorsal, ventral, lateral and end views, ×40. (p. 84)

13—Beyrichiopsis thori Coryell and Johnson. Lateral view, ×40. (p. 84)

14–16—Ectodemites tumidus Cooper. Dorsal, lateral and end views, ×40. (p. 90)

17–18—Coryellites concava (Cooper). Dorsal and lateral views, ×40. (p. 89)

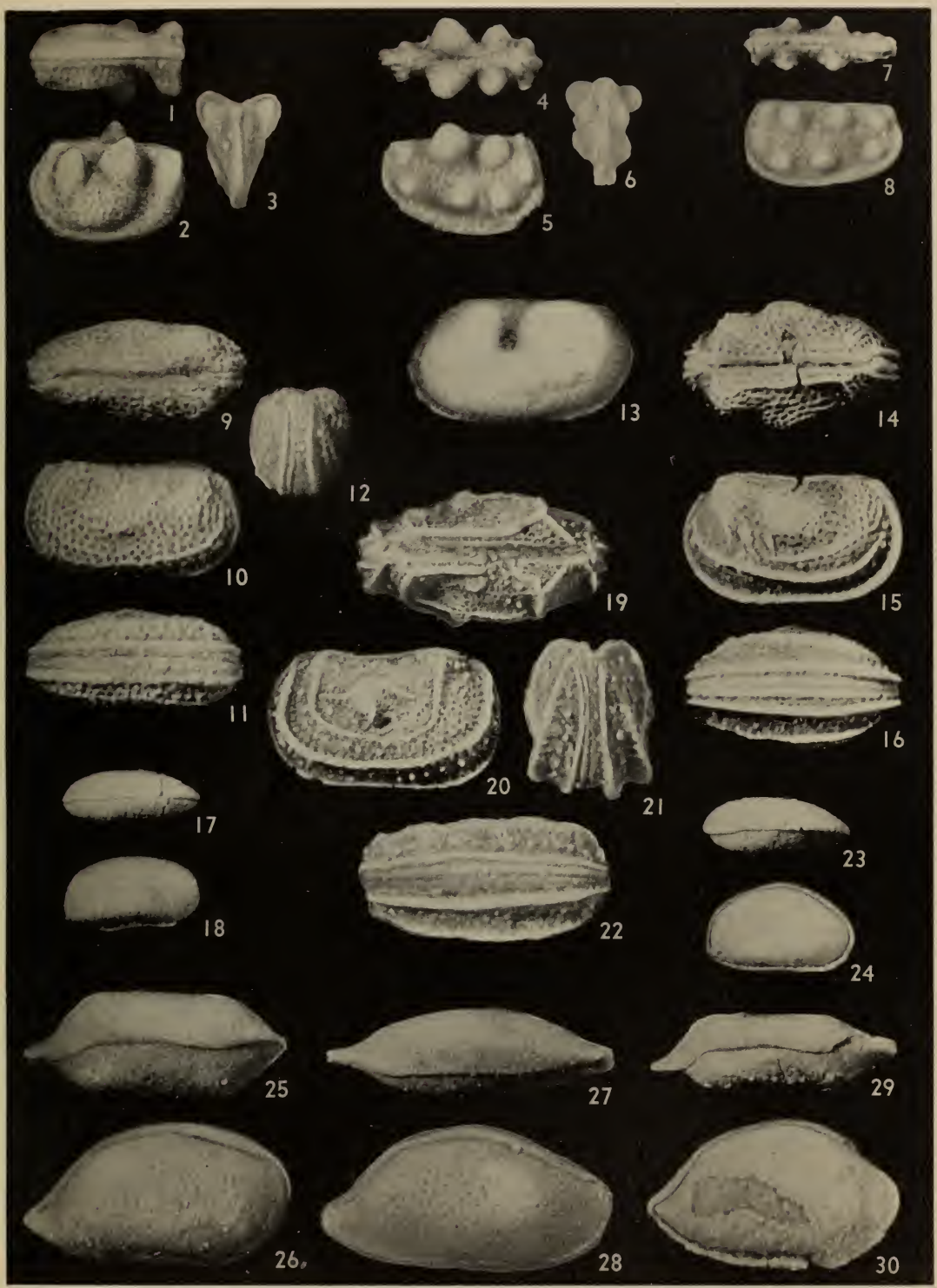
19–22—Amphissites insignis Croneis and Thurman. Dorsal, ventral, lateral, and end views of two specimens (fig. 19, is a single valve), ×30. (p. 84)

23–24—Coryellites portica Cooper, n. sp. Dorsal and lateral views, ×40. (p. 89)

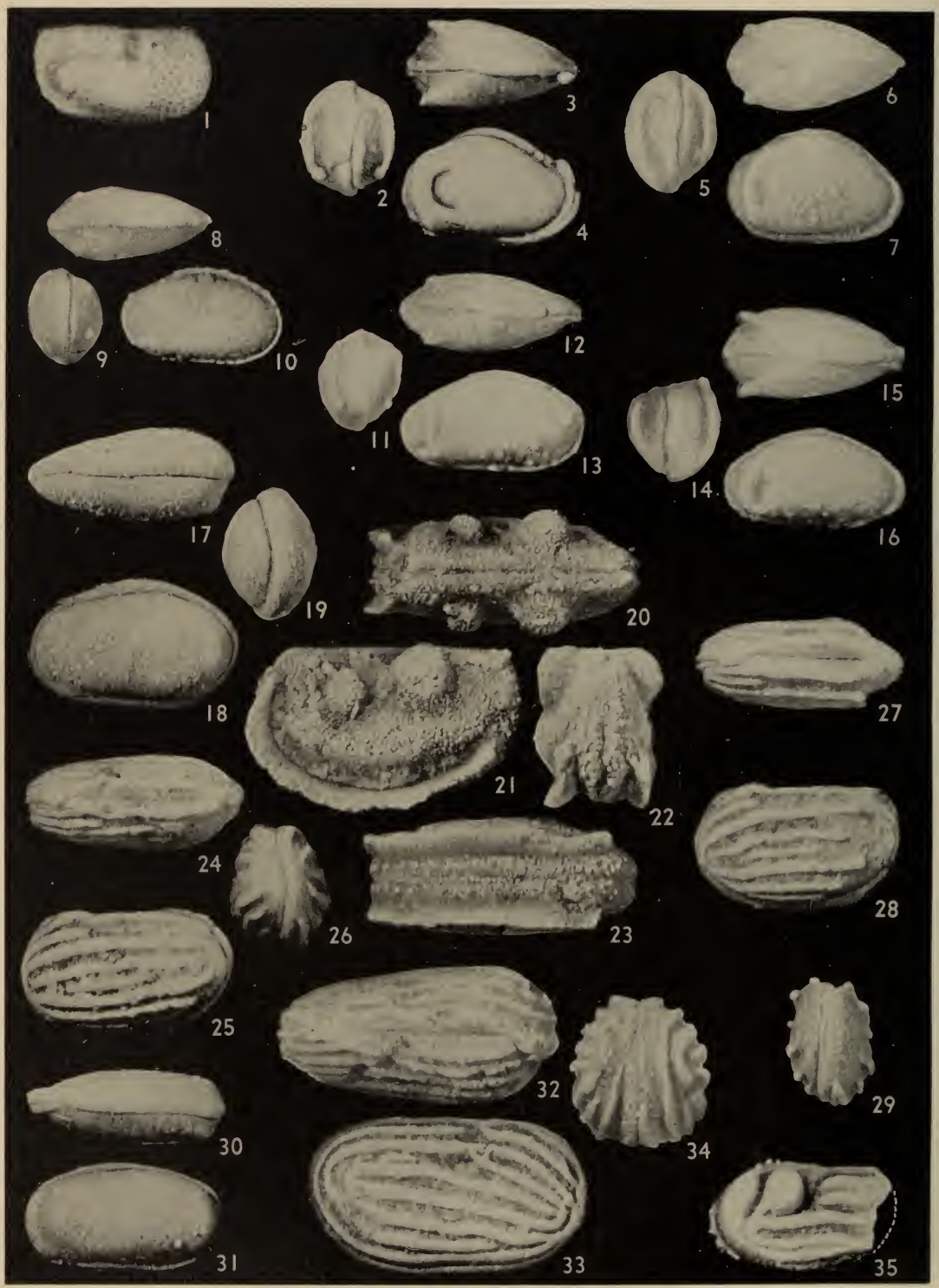
25–26—Bairdia golcondensis Croneis and Gale. Dorsal and lateral views, ×40. (p. 84)

27–28—Bairdia attenuata Girty. Dorsal and lateral views, ×40. (p. 84)

29–30—Bairdia impendere Cooper. Dorsal and lateral views, ×40. (p. 84)



Cooper, Chester Ostracodes



Cooper, Chester Ostracodes

chesterensis by its thicker spirotheca, shorter and thicker septae, its regularity of coiling, and shorter axis. This is one of the smallest described species of *Millerella*.

Kinkaid formation, bed 5, Johnson County, Illinois.

Family AMMODISCIDAE Rhumbler, 1895
Genus GLOMOSPIRA Rzehak, 1888
GLOMOSPIRA DISCA Cooper, n. sp.
Plate 20, figure 18

Test minute, free, early volutions irregularly coiled, but tending to lie within plane of the last coil; tube increases regularly in diameter.

Diameter, 0.23 mm.; thickness, 0.12 mm.

G. disca is smaller and more regularly coiled than *G. siluriana* Ireland, nor is the coiling so irregularly developed as in *G. diversa* Cushman and Waters.

Kinkaid formation, beds 5, 6, Johnson County, Illinois.

Genus TREPEILOPSIS Cushman and Waters, 1928
TREPEILOPSIS MISSISSIPPIANA Cooper, n. sp.
Plate 20, figures 34–41

Test attached to *Productus* spines or free, coiled in a tight conical spiral in early volutions, later becoming a cylindrical coil, finally the tube bends down across the spiral coils in a broadly curved manner that is roughly S-shaped; aperture at end of tube, wide, somewhat flared.

Length (holotype), 0.52 mm.; diameter of tube in last whorl, 0.05 mm.; width of aperture, 0.056 mm.

TABLE 3.—STATISTICAL DATA FOR *M. zelleri*, MEASUREMENTS IN MICRONS

Spec.[3]	Septal count				Diam. Proloc.	L.	W.	Ratio	Ht. volutions					Tunnel angle
	1	2	3	4					1	2	3	4	5	
1	11	14	16	18	20	—	—	—	13	20	27	40	46	—
2	9	11	13	16	20	—	—	—	13	27	33	40	53	—
3	—	—	—	—	23	10	27	1:0.36	13	20	33	40	46	*Ca.* 10°

[3] Specimens 1 and 2 are sagittal sections, and 3 are axial section. Specimen 1 is shown on pl. 19, fig. 8; 2, fig. 6, and 3, fig. 7.

T. mississippiana differs from *S. grandis* Cushman and Waters by the marked curvature of the latter portion of the tube and from *T. spirans* (Cushman and Waters) by the flaring aperture. It can be separated from an undescribed Kinderhook species by the smaller size, tighter coiling, and the long taper of the latter.

EXPLANATION OF PLATE 22

FIGS. *1—Kirkbyella quadrata* Croneis and Gutke. Lateral view, ×50.
2–4—Healdia sulcata Cooper n. sp. Dorsal, lateral and end views of holotype, ×50. (p. 90)
5–7—Healdia caneyensis Harlton. Dorsal, lateral and end views, ×50. (p. 83)
8–10—Healdia aequabilis Cooper. Dorsal, lateral and end views, ×40. (p. 83)
11–13—Healdia elliptica Cooper. Dorsal, lateral and end views, ×50. (p. 83)
14–16—Healdia tenuicosta Cooper. Dorsal, lateral and end views, ×50. (p. 85)
17–19—Cavellina ovatiformis (Ulrich). Dorsal, lateral and end views, ×30.
20–23—Hollinella radiata (Jones and Kirkby). Dorsal, lateral, ventral and end views, ×30. (p. 85)
24–26—Glyptopleura circumcostata Cooper. Dorsal, lateral, and end views, ×40.
27–29—Glyptopleura varians Croneis and Funkhouser, ×40. *32, 34*, Dorsal and end views. *33*, Lateral view of left valve of another specimen.
30–31—Cavellina librata Cooper. Dorsal and lateral views, ×40.
32–34—Glyptopleura similis Croneis and Funkhouser. Dorsal lateral and end views, ×40. (p. 90)
35—Glyptopleurina iniqua Cooper. Lateral view of broken valve, ×40. (p. 85)

Family ENDOTHYRIDAE Rhumbler, 1895
Genus ENDOTHYRA Phillips, 1845

A great variety of species has been assigned to this genus by various workers in this country and abroad, forms ranging from the almost completely evolute *E. gallowayi* Thomas, discoid forms such as *E. ammonoides* Brady and *E. subtilissima* Brady, to such involute species as *E. globula* (d'Eichwald). Many intermediate forms with varying degrees of involution exist, such as *E. ameradaensis* Harlton and *E. media* Waters. Others, partially evolute on one side and involute on the other include the well-known *E. baileyi* (Hall) and the genotype species, *E. bowmani* Phillips. The habit of coiling is also extremely variable, as shown by the regular planispiral of the very flat species to the very great excentricity of thick, bulbous forms exemplified by *E. baileyi*. However, the heterogeneity of the latter species is not so marked as was first supposed, as shown by Scott, Zeller and Nodine (1946), who demonstrate that it has a definite axis of coiling for each half volution. Several species now classified with *Endothyra* probably should be listed with the primitive fusuline *Millerella* Thompson (1942), such as *E. radiata* Brady, *E. globula* (d'Eichwald) (Harlton, 1927) and possibly *E. ornata* Brady to judge from its sagittal section.

ENDOTHYRA ACUTA Cooper, n. sp.
Plate 20, figures 24, 30

Shell medium sized, 8 chambers in last volution; periphery rounded; chambers large and somewhat arched at periphery due to deeply incised sutures as seen in lateral outline; septal angle somewhat less than normal, giving a "backward swing" appearance, especially in last three or four chambers; slightly biumbilicate, the left side being more evolute; apertural face abrupt, not in a plane normal to axis of coiling because the right side of the arch around the aperture has developed faster than the left, making it possible to view aperture from the left side.

Greatest diameter (holotype), *ca.* 0.56 mm.; diameter, last chamber, *ca.* 0.20 mm.; axial thickness, *ca.* 0.19 mm. (These dimensions are approximate as last chamber of holotype is crushed.)

E. acuta resembles *E. whitesidei* Galloway and Ryniker in shape of chambers, but lacks the marked evolute character of the latter. It also has a larger aperture and consequently a higher apertural face than the Pennsylvanian species.

Kinkaid formation, beds 4 and 5, Johnson County, Illinois.

ENDOTHYRA EXCENTRALIS Cooper, n. sp.
Plate 20, figures 19–23

Shell small, thick, 6 to 8 chambers in last volution; periphery rounded; chambers bulbous, especially the final one which is much thicker proportionally than the others; sutures distinct and incised; right side completely involute, left somewhat umbilicate; aperture a crescent-shaped slit located at the base of chamber, extending from the center down the umbilicate side.

Greatest diameter (holotype), 0.48 mm.; diameter last chamber, 0.26 mm.; axial thickness, 0.16 mm.

E. excentra is similar to *E. media* Waters, *E. ovata* Waters, *E. distenta* H. J. Plummer, and *E. rothrocki* Harlton, but the shape of the aperture differentiates it from the first three and the central position of the aperture distinguishes the latter.

Kinkaid formation, beds 4 and 5, Johnson County, Illinois.

Family ASTRORHIZIDAE Brady, 1881
Genus HYPERAMMINA Brady, 1878
HYPERAMMINA cf. H. ELONGATA CLAVATULA HOWCHIN
Plate 20, figures 25–27

Hyperammina elongata clavatula Howchin, 1888, Royal Micr. Soc. Jour., p. 535, pl. 8, figs. 1, 2; Mississippian limestones of England.—Harlton, 1927, Jour. Paleontology, vol. 1, p. 16, pl. 1, figs. 1a, b; Upper Caney shale, Oklahoma.—Harlton, 1933, idem, vol. 7, p. 8, pl. 1, figs. 1a–e; John Valley shale, Okla.

The Kinkaid specimens cannot be distinguished from those occurring above and below the Mississippian-Pennsylvanian boundary in Oklahoma. However, they lack the pointed proloculum of *H. elegantissima* H. J. Plummer, and *H. spinescens* Cushman and Waters and the globular proloculum of *H. bulbosa* Cushman and Waters, reported by Mrs. H. J. Plummer from younger beds in Texas.

Kinkaid formation, bed 7, Johnson County, Illinois.

HYPERAMMINA cf. H. GLABRA Cushman and Waters
Plate 20, figure 33

Hyperammina glabra Cushman and Waters, 1927, Cushman Lab. Foram. Research Contr., vol. 3, p. 146, pl. 26, fig. 1; upper Strawn, Texas.—Cushman and Waters, 1930, Texas Univ. Bull. 3019, p. 33, pl. 2, figs. 1–3; Cisco group, Texas.

This Kinkaid specimen seems to be similar in most respects to the species from the Pennsylvanian of Texas in its small proloculum with a slight constriction above it, followed by a long gradually widening tube that is straight to slightly bowed.

Kinkaid formation, bed 4, Johnson County, Illinois.

HYPERAMMINA sp.
Plate 20, figures 28, 29

The two large fragments apparently belong to this genus but the absence of a proloculum precludes specific designation.

Kinkaid formation, bed 7, Johnson County, Illinois.

Family TEXTULARIDAE d'Orbigny, 1846
Genus PALAEOTEXTULARIA Schubert, 1920
PALAEOTEXTULARIA ASPER Cooper, n. sp.
Plate 20, figures 31, 32

Test biserial, chambers flat, elongate, increasing in size in a regular manner, with sutures parallel and indistinct; aperture a low, central slit at base of apertural face; walls granular.

The biserial arrangement is similar to *Palaeotextularia* sp. Harlton from the Johns Valley shale, but the Kinkaid form is more tenuous and has a more slender aperture. *P. asper* is more stocky than *P. grahamensis* (Cushman and Waters) and has a more elongate aperture but is without the globular chambers of the latter.

Kinkaid formation, bed 5, Johnson County, Illinois.

Subclass OSTRACODA Latreille, 1801

All ostracode species of this fauna are illustrated (pls. 21–23) but descriptions are presented only for those that are new. Descriptions of the others may be obtained readily from the published reports listed in the references. Several short discussions indicate the differentiation of some previously described Kinkaid species from similar Pennsylvanian forms.

Family BAIRDIIDAE Sars, 1887
Genus CORYELLITES Kellett, 1936
CORYELLITES CONCAVA (Cooper)
Plate 21, figures 17, 18

Bythocypris concava Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 28, pl. 3, figs. 3–6; Vienna, Menard and Kinkaid formations, Illinois.

This species described from the upper Chester should have been classified under *Coryellites* for the reasons set forth in the report on the Pennsylvanian ostracodes of Illinois (Cooper, 1946, p. 55).

CORYELLITES PORTICA Cooper n. sp.
Plate 21, figures 23, 24

Carapace ovate, dorsal and ventral margins unequally arched; ventral margin straight; ends rounded; posterior considerably higher and thicker than anterior; overlap moderate and uniform around all margins.

Length, 0.57 mm.; height 0.35 mm.; thickness, 0.23 mm.; form ratio, 1.63.

C. portica resembles *C. subelliptica* (Upson) and *C. johnsoni* (Upson) but is more highly arched and has a more nearly perpendicular posterior margin than these Pennsylvanian species.

Kinkaid formation, bed 1, Johnson County, Illinois.

Family DREPANELLIDAE Swartz, 1936
Genus CORNIGELLA Warthin, 1930
CORNIGELLA TUBERCULOSPINOSA (Jones and Kirkby)
Plate 21, figures 4–6

(For synonomy see Cooper, 1946, p. 78.)

This multinodose form appears in several Chester and Pennsylvanian ostracode zones. The Kinkaid specimens are indistinguishable from those of the Pennsylvanian, typically possessing an elongate, but blunt spinelike node anterodorsally, behind which is another similar but shorter node. All other nodes (there is usually a total of 6 to 8) are

smaller than two near the dorsum. The only other Chester species, *C. golcondensis* (Croneis and Gale), is considerably more elongate.

Kinkaid formation, bed 1, Johnson County, Illinois

Genus VARIX Cooper, n. gen.

Carapace subovate, cardinal angles subequal, with well-defined "swing," free margin (and part of dorsal margin) bordered by a well-defined ridge, central portion marked by irregular, more or less continuous ridges.

Genotype, *Varix propria* Cooper n. sp.

Varix conforms to other genera of the family in its shape and bordering ridge, but the irregularity of its other ornamental features distinguishes it from its near relatives.

VARIX PROPRIA Cooper, n. sp.
Plate 23, figures 12–14

Carapace elongate, subovate, hinge line straight, ends rounded, ventral margin slightly concave; cardinal angles very unequal, the anterior being about 90°, the posterior markedly acute; free margins and part of dorsal margin bordered by a prominent ridge of uniform height and width; central portion of shell marked by an irregular ridge of similar character, subrectangular to subelliptical, the axis of "ellipse" parallel to ventral margin, with a continuation of the ridge inside the "ellipse"; one side of the central portion of the ridge develops into a loop anterior to a shallow circular pit located near midlength; the loop ends posterior to the pit in a small circular node; near the center of the anterodorsal margin the outer loop rises above the hinge line; articulation simple and apparently without overlap.

Length (of holotype), 0.49 mm.; height, 0.38 mm.; form ratio, 1.44.

Kinkaid formation, bed 5, Johnson County, Illinois.

Family GLYPTOPLEURIDAE Girty, 1910
Genus GLYPTOPLEURA Girty, 1910
GLYPTOPLEURA SIMILIS Croneis and Funkhouser
Plate 22, figures 32–34

Glyptopleura similis Croneis and Funkhouser, 1938, Denison Univ. Bull., Jour. Sci. Lab., vol. 33, p. 352, pl. 10, fig. 4.—Cooper, 1941, pl. 7, figs. 23, 24; Clore formation, Illinois.

This species has a rib pattern somewhat similar to *G. coryelli* Harlton in that the rib which is just above the pit bifurcates anteriorly. However, the two species may be distinguished by their differences in lateral outline, the Pennsylvanian species being more quadrate, or not as subelliptical as in *G. similis*.

Kinkaid formation, beds 4–6, Johnson County, Illinois.

Family HEALDIIDAE Harlton, 1933
Genus HEALDIA Roundy, 1926
HEALDIA SULCATA Cooper, n. sp.
Plates 22, figures 2–4

Carapace short, tumid, lateral outline subelliptical; dorsal margin strongly convex, ventral margin nearly straight; posterior ridge curved and directed strongly toward posterior, rising but little above curvature of shell as seen in dorsal view; ridge bordered on anterior side by a deeply incised semicircular furrow of uniform width; overlap prominent around dorsal and ventral margins, each valve developed at ends to produce a slightly incised articulation posteriorly and in irregular flare or "frill" on anterior; surface smooth except for furrow.

Length, 0.52 mm.; height, 0.36 mm.; thickness, 0.29 mm.

H. sulcata is readily distinguished by the unusual furrow in front of the usual posterior ridge which is typical of the genus. However, this should not be confused with the depressed area of *Incisurella* or the trough formed by a row of pits in *Cribroconcha*. Except for the furrow *H. sulcata* is much like many other species such as *H. ornata* Morey and *H. ovoidea* Cooper from the Chester and *H. ehlersi* Bradfield and *H. nucleolata* Knight from the Pennsylvanian.

Kinkaid formation, beds 4–6, Johnson County, Illinois

Family KIRKBYIDAE Ulrich and Bassler, 1923
Genus ECTODEMITES Cooper, 1941
ECTODEMITES TUMIDUS Cooper
Plate 21, figures 14–16

Ectodemites tumidus Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 51, pl. 10, figs. 1–3.

E. tumidus, known only from the Kinkaid,

resembles *E. plummeri* Cooper from the Marble Falls (Texas) and Ferdinand (Indiana) formations of Morrow age, in both size and general shape. However, the ridges of the younger species are more prominent, the reticulations coarser, and the kirkbyan pit larger and almost centered under the medial node. The inner ridge of *E. tumidus* is especially prominent compared to that of *E. plummeri.*

Kinkaid formation, beds 4–6, Johnson County, Illinois.

Family KLOEDENELLIDAE Ulrich and Bassler, 1923

Genus SANSABELLA Roundy, 1926

SANSABELLA HARRISI Croneis and Funkhouser

Plate 23, figures 26–29

Sansabella harrisi Croneis and Funkhouser, 1938, Denison Univ. Bull., Jour. Sci. Lab., vol. 33, p. 334, pl. 9, figs. 7, 8; Clore formation.—Cooper, 1941, Illinois Geol. Survey, Rept. Inv. 77, p. 60, pl. 13, figs. 15, 16; Clore and Kinkaid formations.

Sansabella thurmani Croneis and Funkhouser, 1938, *op. cit.*, p. 336, pl. 9, figs. 11, 12; Clore formation.

Like many other species of *Sansabella* this one is found in two forms, one of which is the mirror image of the other. It resembles *S. carbonaria*, from the Missouri series, but is not so elongate, nor does it have the angulated line of concrescence of the Pennsylvanian species. The younger form also has a more prominent pit.

Kinkaid formation, bed 4, Johnson County, Illinois.

Genus SARGENTINA Coryell and Johnson, 1939

SARGENTINA CRASSIMARGINATA (Croneis and Thurman)

Plate 23, figures 30–34

Sulcella crassimarginata Croneis and Thurman, 1938, Denison Univ. Bull., Jour. Sci. Lab., vol. 33, p. 328, pl. 7, figs. 15, 16; Kinkaid formation.

Sargentina crassimarginata, Cooper, 1941, Illinois Geol. Survey, Rept. Inv. 77, p. 39, pl. 6, figs. 9, 10; Kinkaid formation.

This common Kinkaid species is somewhat larger than representatives of the genus which occur rather high in the Pennsylvanian system. *S. tumida* Cooper from the "Centralia" zone may be distinguished by its greater ellipticity and curved hingeline and *S. elongata* Cooper from the Little Vermilion is more elongated and has a hinge margin that is more nearly straight.

Kinkaid formation, bed 4, Johnson County, Illinois.

CONODONTS Pander, 1856

Genus CAVUSGNATHUS Harris and Hollingsworth, 1933

CAVUSGNATHUS CRISTATA Branson and Mehl

Plate 20, figures 4–10

Cavusgnathus cristata Branson and Mehl, 1940, Denison Univ. Bull., Jour. Sci. Lab., vol. 35, p. 177, pl. 5, figs. 26–31; Caney shale, Oklahoma.

This large species with its high platform and deep trough, and the "cockscomb" development on the oral side is confined to Chester and younger formations. It is much larger than the Pennsylvanian species, and there appears to be little difference between Caney and Kinkaid specimens, except that those from the latter are slightly larger (1.5 mm. and 2.0 mm., respectively).

Kinkaid formation, bed 4, Johnson County, Illinois.

Genus HINDEODELLA Ulrich and Bassler, 1926

HINDEODELLA sp.

Plate 20, figures, 11–13

This genus is represented only by fragments of bars which are not specifically determinable. However, three types of dentition are represented: 1, Large denticles alternating with groups of three smaller ones, and slightly inclined (fig. 11); 2, large denticles alternating with single small denticles, all sharply inclined (fig. 12); and 3, all large denticles sharply inclined to bar (fig. 13). Not enough specimens have been obtained to determine characters that might distinguish them from other Carboniferous species.

Kinkaid formation, beds 1, 4, 6, Johnson County, Illinois.

Genus LIGONODINA Ulrich and Bassler, 1926

LIGONODINA cf. L. LEVIS Branson and Mehl

Plate 20, figure 17

Ligonodina levis Branson and Mehl, 1941, Denison Univ. Bull., Jour. Sci. Lab., vol. 35,

p. 185, pl. 6, fig. 10; Keokuk formation, Missouri.

Although fragmentary, the Kinkaid specimen conforms to this Keokuk species with respect to the fairly heavy, slightly curved cusp, thin bar with thin, discrete denticles; projection probably slight judging from the scar remaining.

Kinkaid formation, beds, 5, 6, Johnson County, Illinois.

Genus PRIONIODUS Pander, 1856

PRIONIODUS SCITULUS Branson and Mehl

Plate 20, figures 1–3

Prioniodus scitulus Branson and Mehl, 1941, Denison Univ. Bull., Jour. Sci. Lab., vol. 35, p. 173, pl. 5, figs. 5, 6; Caney shale, Oklahoma.

This species with its erect cusp, lens-shaped in cross section, with large appressed denticles, free in upper half, and fluted projection, is typically Mississippian.

Kinkaid formation, beds 1, 4–6, Johnson County, Illinois

Genus TAPHROGNATHUS Branson and Mehl, 1941

TAPHROGNATHUS VARIANS Branson and Mehl

Plate 20, figures 14–16

Taphrognathus varians Branson and Mehl, 1941, Denison Univ. Bull., Jour. Sci. Lab., vol. 35, p. 182, pl. 6, figs. 27–41; Keokuk formation, Missouri.

The Kinkaid species is similar in all respects to that from the Keokuk, e.g., in size, shape of bar both orally and aborally, and shape and dentition of the blade.

Kinkaid formation, bed 1, Johnson County, Illinois

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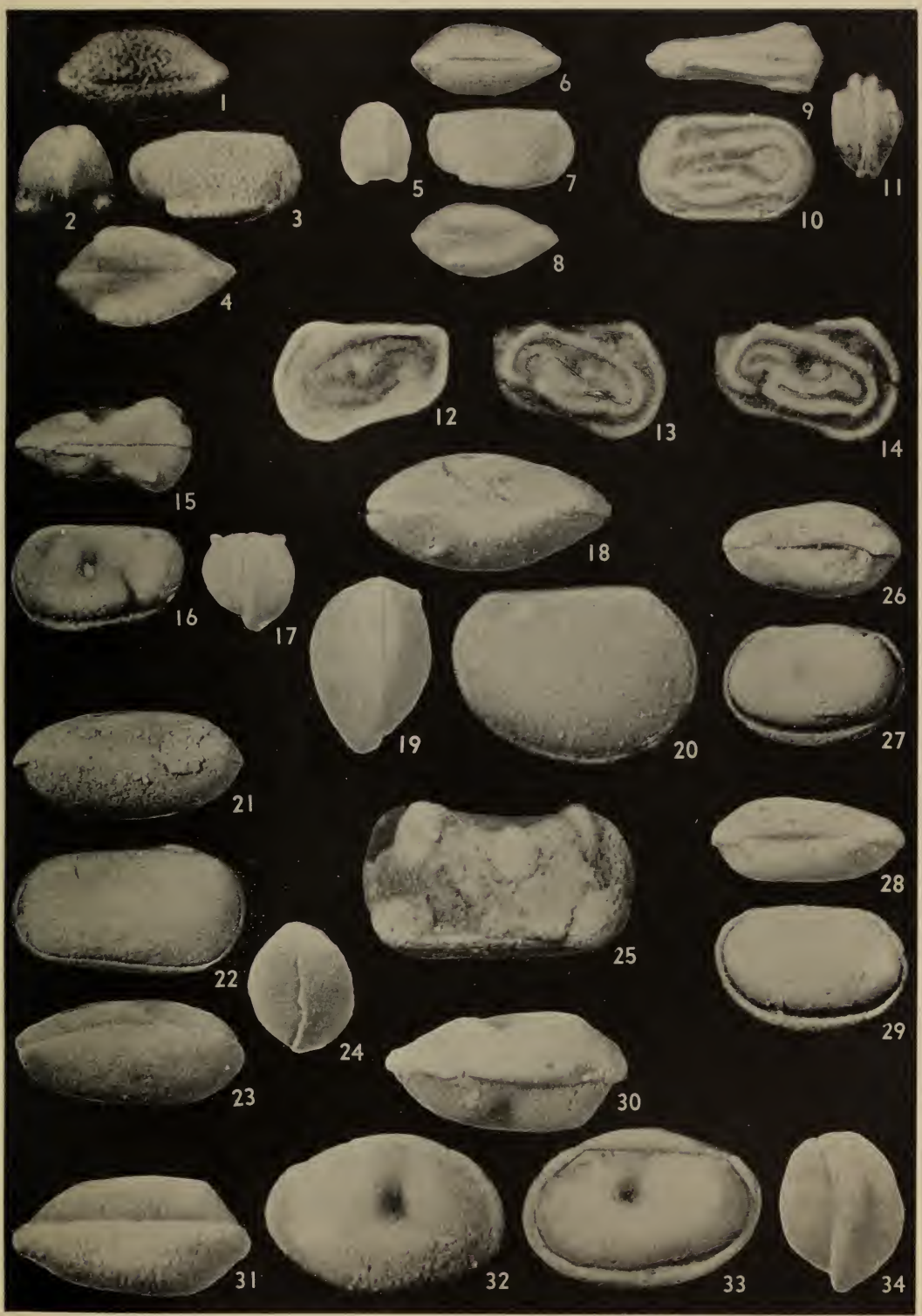
EXPLANATION OF PLATE 23

FIGS. *1–4—Monoceratina celsalobata* Cooper. Dorsal and lateral views, ×50.
5–8—Monoceratina furcula Croneis and Gale. Dorsal, lateral, ventral and end views, ×50.

9–11—Glyptopleura tyri Coryell and Johnson. Dorsal, lateral and end views, ×40. (p. 85)
12–14—Varix propria Cooper, n. gen., n. sp. *12, 13,* Interior and lateral views of holotype; *14,* lateral view of a paratype, ×50. (p. 90)
15–17—Perprimitia funkhouseri Croneis and Thurman, Dorsal, lateral and end views, ×40. (p. 85)
18–20—Paraparchites nicklesi (Ulrich) Dorsal, lateral and end views, ×40.
21–24—Neokloedenella prima Croneis and Funkhouser. Dorsal, lateral, ventral and end views, ×30.
25—Polytylites quincollinus (Harlton) Lateral view, ×40. (p. 85)
26–29—Sansabella harrisi Croneis and Funkhouser. Dorsal and lateral views of reversed forms, ×40. (p. 91)
30–34—Sargentina crassimarginata Croneis and Thurman. Dorsal, lateral, ventral (right and left valves) and end views, ×40. (p. 91)



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